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U.S. DEPARTMENT OF AGRICULTURE

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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief, and the Federal Horticultural Board, C. L. Marlatt, Chairman.

March 31, 1914.

THE POTATO QUARANTINE AND THE AMERICAN POTATO INDUSTRY.

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INTRODUCTION.

In September, 1912, a quarantine order was issued by the Secretary of Agriculture prohibiting the importation of potatoes into the United States from the British Isles, Germany, Austria-Hungary, and from Newfoundland, St. Pierre, and Miquelon, on account of the potato wart. In December, 1913, an additional temporary quarantine was laid against Canada and all the countries of Europe, pending further investigations of the occurrence of powdery scab and the establishment of a system of inspection on the part of foreign governments that will provide for the certification of potatoes offered for export to the United States, to the effect that they are free from disease, that they were grown in a disease-free locality from which the American quarantine has been lifted, and that in other respects they conform to the regulations established by this Government.

The discussion of these quarantines has focused public attention on the potato question to an unusual degree and has emphasized the need for available information concerning the reasons for the quarantines, the nature of the new regulations, and the general status of the potato industry. This bulletin is intended as a contribution to this end. It is sought also to outline a constructive policy for future development that will lessen losses from disease and other wastes and place potato culture on a basis more profitable to the producer, while at the same time permanently reducing the cost to the consumer of this staple food.

Note.—This bulletin tells of the necessity for establishing a quarantine against potatoes from certain countries, gives brief descriptions of the potato diseases that have been imported, indicates some of the agencies by which these diseases have been spread over this country, and gives information that potato growers should have in advance of the planting season. It is intended for general distribution.

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REVIEW OF THE POTATO-DISEASE SITUATION.

When seeking protection from new plant diseases we must be guided by past experience and by our knowledge of the general principles controlling the occurrence and spread of plant parasites. It is evident that agriculture in general bears a burden that increases from year to year as new diseases or insect enemies appear. In colonial times and up to 1840 the potato seems to have been free from many serious pests that have come in since. We now list 18 or 20 diseases, not including insects, that attack potatoes in some part of the United States. The yearly loss from them is difficult to estimate, but the injury from tuber rots and related troubles was recently placed by the Department of Agriculture at over $30,000,000 annually, and diseases which attack the crop in the field probably reduce the value of the harvest by another $30,000,000 per annum.

Not only do new parasites appear at frequent intervals, but they can rarely, if ever, be exterminated. A plant disease, once established here, is likely to be with us forever. Under these circumstances it is to the credit of American farmers that they have, during the last generation, by the adoption of scientific methods of fertilization and culture and by spraying and seed treatment for diseases, maintained the average yield per acre of the country and in the more progressive sections considerably increased it. On the other hand, the average yield is still only about half what it might be, as judged by European standards, and the cost of spraying, increased fertilizers, etc., constitutes a heavy annual tax on the grower.

INTRODUCED PARASITES THE MORE DANGEROUS.

Plant parasites may be divided into two classes, those endemic or native to the country and those introduced from other countries. It is a general principle, fully established by experience, that parasites introduced from other continents or distant parts of the same continent are more injurious than the native parasites of the same crop and more virulent and destructive in their new habitat than they had been at home.

The United States has had many costly examples of this fact, among which may be cited the gipsy moth, the brown-tail moth, the codling moth, the asparagus rust, the hollyhock rust, and that recent immigrant from the Orient, the chestnut bark disease, which is threatening to destroy our chestnut forests.

Several potato diseases are of foreign origin. The examples mentioned below are of special interest.

LATE-BLIGHT.

In the period from 1830 to 1842 there was introduced into both Europe and America a new potato disease which causes a blighting of the foliage, followed by decay of the tubers. This disease, called

late-blight, is worst in moist, not too hot, weather, when it may spread with incredible rapidity, ruining the most vigorous field in three or four days. The same fungus spreads to the tubers, producing a typical dry rot in dry storage, which may become a wet rot in damp soil through bacterial action. The cause of this disease is the late-blight fungus (*Phytophthora infestans*), and its original habitat is believed to be South America. It gained headway soon after its introduction, and in 1845 nearly destroyed the potato crop of Europe, especially in Ireland, and did much injury in America. It has been present every year since to a greater or less extent, and serious outbreaks have recurred periodically when weather conditions favored its development. In North America it is most serious in the northeastern part of the United States and the adjacent provinces of Canada. Thorough spraying with Bordeaux mixture will control it, but the losses are nevertheless still large. There is no hope of the extermination of this disease. Potato growers will always have it to reckon with.[1]

BLACK-LEG.

A disease marked by the blackening and shriveling or softening of the base of the stalk, a typical curling and yellowing of the foliage, and in late cases by an infection and partial decay of the tuber has been introduced from Europe comparatively recently, probably having come first to Canada and thence to Maine. It is a bacterial trouble,[2] transmitted in the seed potatoes. Two points are of special interest: (1) The widespread distribution it has secured within a few years, because seed potatoes are shipped from the district which was the original center of infection to nearly every State in the Union; (2) black-leg takes on a more virulent form under southern conditions and may destroy 10 to 75 per cent of a crop in Virginia when the seed farm in the North had much less of it.

Rigid methods of seed selection and seed treatment will control the disease, and these must be insisted upon.[3]

SILVER SCURF.

An example of the rapid spread of an imported fungus is afforded by the silver scurf (*Spondylocladium atrovirens*). This is a superficial parasite of the potato tuber, beginning as a brown mold on the surface. Later the infected areas take on a glistening silvery gray color, and finally the tubers shrivel more or less, due to loss of

[1] A complete description of the late-blight has been given by Jones, Giddings, and Lutman, in "Investigations of the potato fungus Phytophthora infestans," U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 245, 1912. Obtainable from the Superintendent of Documents, Government Printing Office, for 30 cents.

[2] *Bacillus phytophthorus* Appel and related forms.

[3] The reader desiring more information on black-leg is advised to procure Bulletin 174 of the Maine Agricultural Experiment Station, Orono, Me.

moisture. Silver scurf has been known in Europe for many years, but it was not noticed in America, except in one instance (by Dr. Clinton in Connecticut in 1907), until 1912, when it appeared on potatoes from nearly every State from Maine to Florida and westward to Wisconsin. It is now thoroughly established here and, though a minor trouble, adds another to the agencies which disfigure potatoes. There is evidence to justify the fear that silver scurf may become more injurious in the United States than it has been in Europe.[1]

Other potato parasites have come from the far West or from the South. The migration of the Colorado potato beetle from the Rocky Mountain region is well known. Two diseases, the southern bacterial brown-rot and the Fusarium wilt, appear to be of southern, possibly tropical, origin, though this is not fully established.

THE WART DISEASE.

Potato wart, black scab, or canker is a disease which transforms the tubers into irregular, warty excrescences, at first greenish or white, then black and decaying. It is a fungous disease (*Synchitrium endobioticum*) of comparatively recent discovery, first described from Hungary in 1896 and found in England about 1902 and in Westphalia in Germany in 1908. It has spread considerably during the past decade until it seems firmly established in England and Scotland, has gained a foothold on the coast of Ireland, and has crossed the Atlantic to Newfoundland, where Dr. H. T. Güssow, Dominion botanist, discovered it in 1909. Fortunately, it has not yet been found on potatoes grown in the United States.

Most authorities consider it one of the very serious diseases of the potato, as it converts the tuber into an ugly, irregular, and utterly worthless article, and when established in the soil will attack the succeeding crops and prevent the growing of potatoes in such infected soil for many years.

The countries where the wart occurs have for the most part taken vigorous measures to suppress it, and other nations have endeavored to prevent its introduction. It was primarily on account of this trouble that the Secretary of Agriculture issued Quarantine Order No. 3, September 20, 1912, prohibiting the entry of potatoes into the United States from Newfoundland, the islands of St. Pierre and Miquelon, the United Kingdom (including England, Scotland, Wales, and Ireland), Germany, and Austria-Hungary, although powdery scab was also taken into consideration at that time.[2]

[1] For further details, see the paper in Circular 127, Bureau of Plant Industry, U. S. Department of Agriculture, by I. E. Melhus, entitled "Silver scurf, a disease of the potato." Obtainable from the Superintendent of Documents, Government Printing Office, for 5 cents.

[2] For further information on the wart disease, see Farmers' Bulletin 489.

POWDERY SCAB.

Powdery scab is a tuber trouble, differing from the common scab mainly in the following particulars:[1] The scab spots, or sori, are more often circular and not usually as great in diameter as those of the common (Oospora) scab. They first appear as discolored, slightly raised spots covered by the epidermis, which later breaks away, leaving a pit, filled at maturity with a brownish dust, the spore balls of the parasite. With powdery scab there is less of a corky layer formed under the spot than is the case with common scab. For this reason there is a loss of moisture in storage and the eventual formation of a depressed spot. In severe attacks of powdery scab there is a cankerous stage or eating away of the tuber, which nearly or quite destroys its value. Finally, there is a great difference between the organisms which cause the two kinds of scab. Common scab is due to a parasite (*Oospora scabies*) of very minute, threadlike form, now considered to be more related to the bacteria than to the filamentous fungi. Powdery scab is due to a slime mold (*Spongospora subterranea*), a relative of the cabbage clubroot organism. Its spore balls appear under the microscope as large balls characteristically marked and easily recognized.

Osborn holds that the soil moisture determines to a great extent the damage done by the disease. Under dry conditions of the soil the external appearance is limited to small circular patches about 5 mm. across. Under wet conditions the damage is more serious and the scabs may be as large as 3 to 4 cm. in diameter and as much as 2 cm. in depth.

Powdery scab is common in northern Europe, where it has been known for many years. In Canada it occurs in the provinces of New Brunswick, Prince Edward Island, Nova Scotia, and Quebec, not universally but rather generally distributed in many sections. The disease appears not to be established in the United States except in isolated cases, mostly near the Canadian border, where further surveys are now being made. There is need for the continuance of careful surveys in all States where any imported potatoes may have been planted, to insure the stamping out of any infection that may be present.

POWDERY SCAB IN IMPORTED POTATOES.

Very little is known of the extent to which powdery scab was present in potatoes brought from Europe prior to 1912. In October, 1913, in response to market demands, large shipments of potatoes began to come in from the Netherlands, Belgium, and Denmark, as well as from Canada. Examinations of these potatoes at the ports of New

[1] Cf. Melhus, I. E., Powdery scab (*Spongospora subterranea*) of potatoes, U. S. Department of Agriculture, Bulletin 82, 1914. This publication contains a full description of the disease and the causal parasite.

York and Boston by departmental inspectors showed the presence of powdery scab in most of the arrivals from the Netherlands and in many of those from Belgium and Canada. The percentage of powdery scab varied from a trace up to 20 per cent or more. The scab was usually of the superficial type, though some advanced cases were found. Common scab was also present.

It has been suggested since by the representatives of the Governments of the Netherlands and Belgium that these infected potatoes may have originated in Germany rather than in their countries, and an examination of the situation has indicated that the original quarantine order may not have provided sufficient safeguards against the transshipment of potatoes from Germany and other quarantined countries through Antwerp, Rotterdam, and other nonquarantined ports.

In the situation thus presented, the Department of Agriculture had to determine promptly two points: (1) Is there danger that diseases present on imported potatoes will become established in American fields? (2) Is the powdery scab a new and dangerous disease requiring exclusion by quarantine?

POSSIBLE INFECTION FROM IMPORTED POTATOES.

The greater portion of the foreign potatoes imported are intended for table purposes and are consumed in New York, Boston, and Philadelphia, where it has been urged that by no possibility could infection reach potato fields. The facts, as determined by the Department of Agriculture, are that hundreds of thousands of bushels have been shipped from New York to interior points and that foreign potatoes have been sold as far west as St. Louis and as far south as New Orleans. This was particularly the case in 1911. There are abundant opportunities for disease germs on potatoes used for food to reach the land. Partially decayed or scabby tubers are sorted out by the retailers and disposed of for feeding to live stock, and manure thus infected is hauled to surrounding farms. Parings from the potatoes go into the family garbage can and find their way directly or indirectly to cultivated fields.

A second avenue of infection is through the use of foreign potatoes for seed. It is now fairly well known that European varieties do not succeed in the United States and that the use of foreign seed is not profitable, yet the number of actual instances traced by the Department of Agriculture where European seed potatoes were purposely planted as an experiment or through ignorance of their lack of value, or where unscrupulous dealers had sold foreign stock as domestic, is large enough to show that the danger from this source is a real one. Canadian potatoes are valued for seed purposes and were being bought in large quantities when the quarantine was laid.

The use of foreign sacks which had contained infected potatoes is a third means of spreading disease to American potatoes. Great numbers of these sacks are gathered up through secondhand dealers and sold in New York, Maine, and other producing centers for use in shipping domestic potatoes. It has not been the practice to sterilize these sacks, though a treatment with steam would render them safe.

The conclusion reached after consideration of the possibility of the spread of disease through garbage, seed potatoes, and reused sacks was that it will be impossible to prevent the permanent establishment in the United States of any parasitic disease common on imported potatoes.

IS THE POWDERY SCAB DANGEROUS?

The Federal Horticultural Board was compelled to decide promptly whether the best policy for the country would be to treat powdery scab as a disease of minor importance and make no restrictions on importations from infected countries, recognizing as inevitable that the disease would soon become common and widely distributed in the United States, or whether it should be considered sufficiently dangerous to warrant exclusion measures. In deciding this important point all available information was secured. Advice was sought from the plant pathologists in the several State experiment stations, all foreign publications on the subject were consulted, and the advice of representatives of foreign governments was taken through correspondence and at a public hearing held in conformity with the plant quarantine act on December 18, 1913. This hearing was attended by a large number of plant pathologists and other State officials, by representatives of farmers' organizations and commercial bodies, and by interested individuals. The thousands of letters, petitions, and telegrams received by the board showed that the potato growers of the country are no longer apathetic on the question of potato diseases.

The advice of the foreign representatives was to the general effect that European potatoes had been imported in large quantities for many years; consequently, that if powdery scab were communicable it must be common in the United States, but overlooked, in which event a quarantine would not be lawful under the plant quarantine act. Further, that if powdery scab had not already become established, this fact should be considered as evidence that no danger exists.

It was also represented that powdery scab is a disease of such minor importance that the interruption of trade by a quarantine was not justified, and that, if introduced, it could be controlled by using no infected tubers for planting and by discontinuing the use of infected land for growing potatoes. The evidence on each of these points and on other phases considered is summarized later.

OCCURRENCE IN THE UNITED STATES.

During the past two years the pathologists of the Department of Agriculture have visited every important potato section to look for powdery scab and other diseases. Potatoes in the large markets have been examined, the Plant-Disease Survey collaborators in the several States have been asked to be on the watch for powdery scab, and the State of Maine has been given special attention by both the department and the State experiment station.

Outside of the State of Maine no definite cases have been traced to farms, but some evidence of powdery-scab infection was found by Dr. Morse, of the Maine experiment station, in two sendings of potatoes from western Nebraska and Massachusetts.

Considerable powdery scab has been found in Maine very recently. This infection is most abundant on the northern border of Aroostook County, but scattered cases occur elsewhere, many of which have been traced directly to seed potatoes brought over from the infected districts of Canada. Thus far only a very small percentage of Maine farms has been found infected.

The State authorities have taken prompt and vigorous action to survey the State in order to locate all infections. An inspection service has been organized, which will issue certificates of freedom from powdery scab, and no potatoes known to be diseased will be allowed to leave the State. Seed stock will be examined with special care.

It is believed that these measures will provide an adequate safeguard against the future spread of powdery scab to other States. The State of Maine expects to quarantine all infected fields and will endeavor to stamp out the disease.

A more thorough survey of other States is now under way. The evidence is very strong that at the present time powdery scab is not "widely distributed in the United States."

LIKELIHOOD OF SPREAD.

That the disease has not already gained a greater foothold in spite of numerous importations is perhaps the strongest argument advanced by the opponents of a quarantine. This is probably a matter of good fortune rather than proof of noncommunicability. The contrary evidence includes its apparent general occurrence in certain foreign districts, the fact reported by Dr. Melhus that in Canada those sections which use European varieties and which often import seed are more infected than those using seed from American sources, and the experimental evidence secured by Dr. Morse in Maine and by Irish workers that the disease is readily communicable by planting infected seed potatoes.

RELATIVE IMPORTANCE IN EUROPE AND THE UNITED STATES.

Powdery scab has been in the past a minor potato disease in Europe; that is to say, it has not been recognized by the public as a serious trouble, nor has it engaged the time and attention of scientific investigators to the extent that other potato diseases, such as leaf-roll, have. Recent publications by Johnson and by Pethybridge, the leading plant pathologists of Ireland, lead to the conclusion that the disease is more serious there than has previously been realized, particularly in gardens and fields continuously cropped in potatoes, where it tends to assume the cankerous stage and reduces the market value of the potatoes for eating purposes. It may well be that powdery scab is becoming more serious in Europe. Johnson states:

> I have no doubt myself that Spongospora scab has a good deal to do with the miserable average yield per acre of potatoes in the west of Ireland. * * * It is in some districts of Ireland as injurious to potatoes as finger-and-toe is to turnips.

DIFFERENCES IN MARKET STANDARDS.

An important consideration in this connection is that any scab or other disfigurement of the tuber reduces its market value much more in the United States than in Europe. The consumer abroad does not object seriously to a scabby potato. In fact, we are assured by our English visitors that it is a general belief in Great Britain that scab is an indication of good quality for eating purposes. In the United States, however, scabby potatoes are rejected for market purposes. In Maine they were sorted out and sold to the starch factory for 50 cents per barrel as compared with $1.50 which they would have brought if clean. In communities where there are no starch factories the scabby potatoes are fed to stock or left lying in the field. As a consequence, scab-infected fields are worthless for potato growing and their market value is greatly impaired.

SCAB DISEASES WORSE IN THE UNITED STATES THAN IN EUROPE.

Powdery scab has not occurred in the United States to an extent that permits any comparison of its virulence here with its behavior in Europe. It is, however, a well-known fact that introduced troubles as a class are more destructive than in the country of origin, owing to differences in climate or other conditions. The several important potato districts of the United States—Maine, New York, the trucking districts of the Atlantic seaboard, the northern Great Lake district, the Red River Valley, Colorado, Idaho, Oregon, California, etc.—differ exceedingly in soil and climate, and there is reason to fear that powdery scab might find in one or several of these districts conditions much more favorable than exist in Europe and that it would assume a more virulent form.

It is certain that our common scab is much more common and disfiguring throughout the United States than it is in Europe, and the injuries caused by the fungus Rhizoctonia to potatoes in the West are greater than any reported from Europe.

COMPARISON OF POWDERY-SCAB INJURIES.

Common scab produces a roughened spot or pockmark on the tuber, which in its worst stage may cover the whole potato. Underneath the scab spots, however, a cork layer is formed and the potato remains sound. It is not more subject to decay than other potatoes, and the actual injury from a food standpoint is due to the greater loss in peeling before cooking.

Powdery scab in its milder form causes no greater outward disfiguration than common scab, but there is less of a cork layer formed and a progressive decay frequently follows. The cankerous stage of powdery scab is more objectionable than any phase of common scab and is as bad as the wart disease. Finally, no means of controlling powdery scab through the disinfection of seed potatoes, as practiced for common scab, has proved wholly satisfactory.

All these considerations led the Department of Agriculture to the conclusion that measures for preventing the introduction of powdery scab into the United States were not only fully justified, but were demanded by every rule of prudence and precaution.

Most foreign countries have long since wisely adopted a similar procedure with reference to American potatoes, mainly on account of the Colorado potato beetle. Canada maintains a complete embargo against all European countries, and most of the English colonies restrict the importation of potatoes to a greater or less extent on account of the wart disease and other troubles.

OTHER REASONS FOR POTATO REGULATIONS.

Experience gained in the enforcement of the potato quarantine order of September 20, 1912, and further investigations of potato diseases and insect enemies have shown that more efficient and logical means are required for the adequate protection of this country against the potato parasites of the world.

Where a quarantine is laid against a whole country on account of an infection limited to a small portion of that country, the justice of the act is questioned by residents of the disease-free districts, yet there has been no means of limiting quarantines by other than national boundaries except through the active cooperation of the foreign government.

Where a quarantine is laid against one country and not against another concerning a commodity like potatoes, which is a staple ar-

ticle of trade between the two nations, it is very difficult to prevent transshipments from the quarantined country through the ports of the nonquarantined country unless special measures are taken by the governments concerned to regulate such trade.

Finally, it is impossible to foresee all the conditions that will arise in the course of international commerce. Shipments come from new sources and may bring parasites hitherto unknown to which existing regulations may not apply. An example is afforded by some small importations of potatoes from South America in 1913, which were found infested with new species of weevils, more dangerous than any previously known, which tunnel through the tuber and destroy its value without greatly impairing its appearance.[1] This finding emphasizes the necessity of maintaining a careful watch over all potatoes coming from South or Central American sources. Effective regulations are therefore to be preferred to quarantines, in order to permit the most complete protection against the introduction of parasites without hampering trade more than is necessary.

A step in this direction has been taken by the issuance of the following order applying to potatoes the provisions of the nursery stock regulations, under the plant quarantine act:

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
FEDERAL HORTICULTURAL BOARD.

ORDER COVERING ADMISSION OF FOREIGN POTATOES UNDER RESTRICTION.

The Secretary of Agriculture has determined that the unrestricted importation from any foreign country of the common or Irish potato grown in the Dominion of Canada, Newfoundland, Great Britain, Ireland, Continental Europe, and other foreign countries may result in the entry into the United States, its Territories and Districts, of injurious potato diseases, including the powdery scab (*Spongospora subterranea*), and injurious insect pests.

Now, therefore, I, DAVID F. HOUSTON, Secretary of Agriculture, under authority conferred by section 5 of the act of Congress approved August 20, 1912, known as "The Plant Quarantine Act" (37 United States Statutes at Large, page 315), do hereby determine and declare that on and after January 15, 1914, common or Irish potatoes imported or offered for import into the United States or any of its Territories or Districts shall be subject to all the provisions of sections 1, 2, 3, and 4 of said act of Congress.

Done at Washington this 22d day of December, 1913.

Witness my hand and the seal of the United States Department of Agriculture.

[SEAL.] DAVID F. HOUSTON,
Secretary of Agriculture.

[1] Pierce, W. Dwight. Journal of Agricultural Research, vol. 1, no. 4, p. 347–352, pl. 3, 1914.

Pending the completion of arrangements with foreign governments for the survey and delimitation of disease-free districts and for the inauguration of a system of inspection and certification of potatoes, a temporary quarantine was laid, as follows:

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
FEDERAL HORTICULTURAL BOARD.

NOTICE OF QUARANTINE NO. 11 (FOREIGN).

POTATO QUARANTINE.

The fact has been determined by the Secretary of Agriculture that injurious potato diseases, including the powdery scab (*Spongospora subterranea*), new to and not heretofore widely prevalent or distributed within and throughout the United States, exist in the Dominion of Canada, Newfoundland, the islands of St. Pierre and Miquelon, Great Britain, Ireland, and Continental Europe, and are coming to the United States with imported potatoes.

Now, therefore, I, DAVID F. HOUSTON, Secretary of Agriculture, under the authority conferred by section 7 of the act of Congress approved August 20, 1912, known as "The Plant Quarantine Act" (37 United States Statutes at Large, page 315), do hereby declare that it is necessary, in order to prevent the introduction into the United States of such potato diseases, to forbid the importation into the United States, from the countries hereinbefore named, of the common or Irish potato (*Solanum tuberosum*) until such time as it shall have been ascertained, to the satisfaction of the Secretary of Agriculture, that the country or locality from which potatoes are offered for import is free from such potato diseases.

On and after December 24, 1913, and until further notice, by virtue of said section 7 of the act of Congress approved August 20, 1912, the importation, from the countries hereinbefore named, of the common or Irish potato, except for experimental or scientific purposes by the Department of Agriculture, is prohibited: *Provided*, That shipments of such potatoes loaded prior to December 24, 1913, as shown by consular invoices, will be permitted entry up to and including January 15, 1914.

Done at Washington this 22d day of December, 1913.

Witness my hand and the seal of the United States Department of Agriculture.

[SEAL.] DAVID F. HOUSTON,
Secretary of Agriculture.

A GENERAL QUARANTINE NOW IN EFFECT.

The order quoted above has resulted in the stoppage of potato importations from Canada and all the countries of Europe for an indefinite period. It is not known at present how many of these countries will ultimately qualify for the lifting of the quarantine, but the apparent general distribution of powdery scab in many of them makes it improbable that they will resume shipments to the United States in the near future. Certain portions of Canada are reported to be nearly free from powdery scab, and the vigorous campaign now being waged there against the disease offers hope that the restriction may be modified with respect to specified districts at an early date.

The initiative in lifting the quarantine rests with the foreign government, which must notify the United States that specified dis-

tricts have been surveyed and found to be free from wart and powdery scab and that they are ready to inspect and certify potatoes intended for export, in conformity with our regulations.

Such action has now been taken by the Kingdoms of Belgium and Denmark, and on February 20, 1914, the quarantine was lifted from these countries by an order of the Secretary of Agriculture, and hereafter their potatoes may be imported into the United States subject to and in accordance with the general regulations referred to. These regulations have been issued in printed form, and all persons desiring full details, especially as to the procedure to be followed in making importations, should procure an official copy.[1]

GENERAL EXPLANATION OF REGULATIONS.

Control of importations is secured through a system of permits, as already in force for nursery stock. The importer makes his application to the Federal Horticultural Board at Washington, on forms provided, and receives a permit authorizing him to import potatoes from a specified firm and district from the time of issuance until June 30 following. A permit for each shipment is not required. Notice must be given to the board when each shipment arrives. For details, the regulations should be consulted.

IMPORTATIONS ALLOWED FROM DISEASE-FREE DISTRICTS ONLY.

The regulations provide that before the quarantine is lifted or permits are granted for importations from any country the officials of that country shall determine by a field survey, or in the case of the present crop by a cellar or pit inspection, that the country or district is entirely free from wart and powdery scab.

It is not intended that there shall be any attempt made to separate by sorting the clean from the infected potatoes. The warning has been emphatic from all pathologists consulted that such an inspection would be utterly impracticable; that if any disease was present in a lot of potatoes it would be out of the question to sort them under commercial conditions without overlooking some disease. Infection might also be carried on healthy potatoes that had been in contact with diseased tubers.

It is believed by the Federal Horticultural Board that the freedom of a district from disease can be determined with sufficient accuracy to afford a reasonable safeguard when checked by the foreign inspection and by inspection on arrival at the port of entry.

Prevention of transshipments from quarantined districts is accomplished through the cooperation of the foreign government, which must provide an "effective quarantine" against districts quarantined

[1] Regulations governing the importation of potatoes into the United States under the provisions of the order of the Secretary of Agriculture issued December 22, 1913.

by the United States. This may be done by a decree prohibiting the exportation to the United States of potatoes not grown in the country taking the action.

CERTIFICATE OF INSPECTION.

No potatoes are to be admitted to the United States under the new regulations unless they are accompanied by a certificate issued by an official authorized of the country of origin, stating that they were grown in a specified disease-free district or locality, that they have been inspected by him and found free from dangerous insects and plant diseases, and that they are packed in containers that have never been used for potatoes. An original certificate of this nature must accompany the invoice when presented at the customs office, and a copy of the certificate must be attached to each sack, barrel, or other container. Provision is made for bulk carload shipments, but not as yet for wagonloads hauled across the border.

INSPECTION ON ARRIVAL.

Shipments will not be released from customs until inspected by a representative of the Federal Horticultural Board and found free from dangerous diseases. If powdery scab or wart is discovered the shipment must be exported or destroyed.

The most important safeguard provided is the limitation of imports to potatoes grown in disease-free districts or countries and the foreign inspection and certification. The port of entry inspection in the United States serves as a check on these, but is not a sufficient means in itself, for the reasons already stated and because only a portion of each shipment can be carefully looked over without maintaining an army of inspectors.

LIMITATION OF PORTS OF ENTRY.

The right is reserved under the new regulations to restrict importations of potatoes to ports of entry named by the Federal Horticultural Board when the permit is granted. It is manifestly impossible to maintain an inspection service at each customs office, and at the outset it is probable that entries will be allowed regularly only at New York and Boston, with the exception of special cases where it proves feasible to have inspections made elsewhere. By far the greater part of the potatoes imported in past years have come to the port of New York. Permits must be secured in advance of importation in all cases.

ADDITIONAL SAFEGUARDS.

If inspection at the port of entry shows that potatoes are infected with the wart disease or with powdery scab or other injurious plant diseases, or with injurious insect pests, the shipments will be refused

entry. Permits for the entry of potatoes may be refused and existing permits may be canceled on proof that the certificate of inspection does not correctly give the locality where the potatoes were grown, the character of the shipment as to freedom from disease or insect infestation, or falsely states that the containers have not been previously used for the shipment of potatoes.

Permits may be canceled and further permits refused for the importation of potatoes from any country whenever such potatoes, in the judgment of the Federal Horticultural Board, are found to be so infected as to indicate plainly that the foreign inspection is merely perfunctory, or if the permittee fails to give to the Secretary of Agriculture and to the duly-authorized inspector of the department at the port of entry designated in the permit notices of the arrival of potatoes or gives a false notice.

IMPORTATIONS FROM NONQUARANTINED COUNTRIES.

Potatoes will be allowed to enter from sources other than Canada and the countries of Europe when properly inspected and certified by the authorized officials of the country of origin. The importers must comply with the permit requirements already mentioned.

Bermuda has complied fully with the regulations by prohibiting the importation of potatoes from Canada and Europe and by inaugurating a rigid inspection service. The importation of potatoes from these islands has therefore continued without check.

The total quantity of potatoes brought from Bermuda during the year ended June 30, 1913, was 141,422 bushels. These are all entered at New York and find a special market at a high price. None are used for planting in the United States.

The importation of potatoes from the State of Chihuahua, in Mexico, having been determined by an inspector of the Department of Agriculture to be attended by no risk from insects or diseases, the requirement of foreign certification has been waived temporarily in consideration of existing conditions in Mexico, and permits are being granted for such importations, from Chihuahua only, subject to inspection at El Paso, Tex., the port of entry.

Last year's importations from Mexico amounted to 8,301 bushels.

RELATION OF IMPORTED TO DOMESTIC POTATOES.

The total imports of potatoes into the United States make up a very small proportion of the total consumption, as may be computed from Table I. For the five years, 1907–1911, preceding the quarantine, the imports minus the exports were 1.03 per cent of the estimated production.

TABLE I.—*Acreage, production, value, prices, exports, and imports of potatoes in the United States, 1900 to 1912, inclusive.*

Year.	Acreage planted and harvested.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	For fiscal year beginning July 1.	
						Domestic exports.	Imports.
		Bushels.	*Bushels.*	*Cents.*		*Bushels.*	*Bushels.*
1900	2,611,000	80.8	210,927,000	43.1	$90,811,000	741,483	371,911
1901	2,864,000	65.5	187,598,000	76.7	143,979,000	528,484	7,656,162
1902	2,966,000	96	284,633,000	47.1	134,111,000	843,075	358,505
1903	2,917,000	84.7	247,128,000	61.4	151,638,000	484,042	3,166,581
1904	3,016,000	110.4	332,830,000	45.3	150,673,000	1,163,270	181,199
1905	2,997,000	87	260,741,000	61.7	160,821,000	1,000,326	1,984,160
1906	3,013,000	102.2	308,038,000	51.1	157,547,000	1,530,461	176,917
1907	3,128,000	95.4	298,262,000	61.8	184,184,000	1,203,894	403,952
1908	3,257,000	85.7	278,985,000	70.6	197,039,000	763,651	8,383,966
1909	3,525,000	106.8	376,537,000	54.9	206,545,000	999,476	353,208
1910	3,720,000	93.8	349,032,000	55.7	194,566,000	2,383,887	216,984
1911	3,619,000	80.9	292,737,000	79.9	233,778,000	1,237,276	13,734,695
1912	3,711,000	113.3	420,647,000	50.5	212,550,000	.....	.....

THE 1913 POTATO CROP.

The potato crop of the United States for 1913 is estimated to be 238,946,000 bushels. The principal shortage is in the Central States, which are not the leading potato States. Comparisons to determine the actual needs of the country can not fairly be made with the 1912 crop, which was so large that hundreds of thousands of bushels went to waste for lack of a market and millions of bushels were sold for less than the cost of production.

The following is quoted from the department's Weekly News Letter to Crop Correspondents, January 28, 1914:

FIRMER HOLDING OF POTATOES BY THE FARMERS.

SUPPLY IS NEARLY NORMAL, BUT DISTRIBUTION IS UNUSUALLY UNEVEN—PRINCIPAL POTATO-PRODUCING STATES HOLD SUPPLIES, WITH SHORTAGE IN A NUMBER OF CONSUMING STATES.

The yearly estimates of the amount of potatoes remaining in growers' hands and the stocks in dealers' hands on January 1 in the important potato States, just completed by the Bureau of Statistics (Agricultural Forecasts), United States Department of Agriculture, indicate that a larger proportion of the marketable crop of potatoes was still in the hands of farmers on January 1 than had been the case for four years past. The proportion estimated to be in dealers' hands was smaller than for any year of the four except January 1, 1912. The figures showed that the total estimated potato production was below normal, but, owing to the slow movement of the crop up to January 1, the supply for the remainder of the year will be almost normal. Distribution, however, seems to be unusually uneven. The holdings of potatoes are relatively large in the important producing States of Maine, Michigan, Wisconsin, and Minnesota; and relatively small in New York, Ohio, Indiana, Illinois, Iowa, and Kansas, which are important both as potato-producing and potato-consuming States.

In consequence of the firm holding by farmers the price early in the season has been unusually high, being on December 1 about 17½ cents per bushel higher than

a year ago and 16½ cents higher than three years ago, but 11½ cents lower than two years ago, when potatoes on January 1 were selling for 77½ cents per bushel and the supply was unusually short, owing to the drought of the previous year.

Present conditions do not seem to forecast material, if any, advance in prices in the important producing States this year. In 1911, when supplies were but moderately larger than now, and in 1913 the price movement after January 1 was downward instead of upward. The only other factor which may enter to change the experience of 1911 and 1913 is the somewhat different distribution of the crop which exists this year.

Southern growers who plant in the spring for the early market would seem to be justified, from present conditions, in putting out a normal acreage, but should not expect the big advance in prices which prevailed two years ago.

The estimates indicate that about 42.1 per cent of the marketable supply of potatoes of the 1913 crop remained in the hands of farmers and 9.5 per cent in the hands of dealers on January 1 in the important potato-growing States. These figures compare with 39.8 and 9.8 per cent similarly estimated a year ago, 33.1 and 8.6 per cent two years ago, 40.2 and 10.9 per cent three years ago, and 41.2 and 9.9 per cent four years ago. If, for the purpose of comparison, these percentages were applied to the estimates of total production, it would show total stocks of 123,000,000 bushels on January 1, 1914 (in the 19 States analyzed below), compared with 150,000,000 a year ago, 91,000,000 two years ago, 133,000,000 three years ago, and 142,000,000 four years ago. These figures would indicate that the quantity to be carried toward the close of the season will not be sufficient to cause depressed prices, as was the case particularly four years ago (in some States last year, also), nor, on the other hand, will they be so scant as to cause such high prices as prevailed in the spring of 1912.

To show the relation between supplies and prices, the following tabulation is given, showing for the past five years the production, stock on hand January 1, and the prices paid to producers on December 1 and the following March 1 in 19 important potato-growing States:

Years.	Total production (bushels).	Stocks on Jan. 1.					Farm prices.	
		In growers' hands.		In dealers' hands.		Total (bushels).	Dec. 1.	Mar. 1.
		Per cent of crop.	Bushels.	Per cent of crop.	Bushels.			
1913–14	238,946,000	42.1	100,495,000	9.5	22,797,000	123,292,000	66.2	.....
1912–13	304,126,000	39.8	119,678,000	9.8	30,167,000	149,845,000	48.6	47.7
1911–12	217,532,000	33.1	72,072,000	8.6	18,706,000	90,778,000	77.6	101.4
1910–11	261,141,000	40.2	104,954,000	10.9	28,463,000	133,417,000	49.5	46.9
1909–10	298,308,000	41.2	122 997,000	9.9	29,384,000	142,381,000	50.0	47.3

A PROGRESSIVE POLICY NEEDED.

The present situation emphasizes the fact that potato production in the United States is not on a sound economic basis. We have an almost regular alternation of seasons when more potatoes are produced than can be consumed and prices fall below production costs in many instances and of seasons of short crops when prices are unreasonably high to the consumer. This condition is reflected in the imports and exports, as shown in figure 1.

It will be noted that during seven years of the twelve, more potatoes were exported than were imported, while during five years the imports exceeded the exports.

The possibilities of potato production in the United States are almost unlimited. All of the States could increase their acreage and their average yield, and there exist in many northern districts, particularly in Maine, Michigan, Wisconsin, and Minnesota, large areas of cut-over lands, recently in forest but now being brought under cultivation, which could produce many times more potatoes than at present. The same is true of the irrigated West. Under present economic conditions, however, no material increases in acreage could be made without risk of overproduction.

Among the most striking features of potato culture in the United States are the low average yield per acre, the relatively high cost of production per bushel, the distance from markets of many important

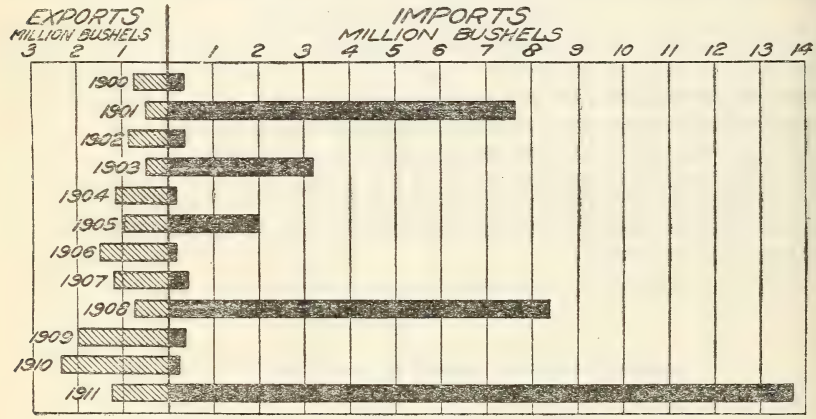

FIG. 1.—Exports and imports of potatoes for the United States during the years 1900 to 1911, inclusive, showing graphically the alternating seasons of overproduction and scarcity.

potato districts, and the fluctuations in the market price, which make potato growing rather a speculative enterprise.

To insure permanent prosperity there is a real need for the adoption of a constructive policy that will strike at the roots of the present difficulties, a policy of which quarantines or the regulation of imports are only minor phases, for foreign potatoes must of necessity in the future play a still smaller rôle than now in supplying food to the people of the United States as our population increases and as the European crop will be more and more needed for home consumption.

PROTECTION FROM DISEASE.

In view of the already excessive losses from diseases and insects, it is apparent that it is of national importance to prevent the introduction of more pests of this nature from other countries, a protection which is afforded through the plant quarantine act.

The quarantine law is, however, not the best means of controlling diseases already existent within our borders, for it does not provide authority for quarantining a single farm or a limited district in one of the States except as to interstate shipments. It is, therefore, of the highest importance that each State enact legislation authorizing the proper State officials to search for suspected cases of new or dangerous diseases and empowering them in the event of their discovery within the State to destroy infected stock or material, to put under quarantine the areas involved, and to take other measures needed to prevent the spread of the trouble. In some States such laws exist for nursery stock, but they do not always cover potatoes. It is particularly in States doing a large business in seed potatoes that such legislation is needed.

The fact that many diseases, like the black-leg, dry-rot, scab, and eelworm, are scattered far and wide on infected seed also makes necessary some community or State action to control these troubles at the source by stimulating the growing of seed potatoes as a special business and by establishing a system of inspection and certification that will provide a means by which distant purchasers can be guaranteed the freedom from disease of potato seed stock purchased, as well as its varietal purity and vigor.

At present, the consumer shares the loss from potato diseases, whether in the field, in storage, or en route to market. Much of the loss can be prevented by better spraying or better methods of grading, handling, and shipping, which have not yet been worked out and adopted on account of a lack of concerted action and community of interest on the part of buyers, shippers, jobbers, and retailers. These men can assist the grower in lowering the present excessive retail prices of potatoes.

LACK OF AN OUTLET FOR SURPLUS POTATOES.

Under present conditions the production of potatoes is limited by the requirements of the market for table stock. A few culls are made into starch and a few fed to stock, but there is no extensive use of potatoes for industrial purposes such as one finds in Europe.[1]

Furthermore, the production in the United States is greatly influenced by weather conditions, especially by the occasional periods of heat or drought to which we are more subject than Europe and to which the potato is more sensitive than some other crops.

The result is that when we add to these two factors the natural tendency of farmers to reduce their acreage after a year of low prices and to increase it after a year of high prices, we have the excessive fluctuation in supply and market prices already described.

[1] Cf. Department of Agriculture, Bulletin 47.

Some means of disposing of surplus potatoes is an economic necessity. If this can be done at a price reasonably above the cost of production, the potato crop will increase and a reserve supply of potatoes grown for industrial uses will be established that will meet the needs of all short years.

Diversification or the introduction of better farming systems will be a step in this direction. Means should be worked out for keeping more live stock, especially swine, on potato farms, and a better understanding of the feeding value of potatoes and of the best rations combining potatoes with other feeds should be secured.

The industrial uses of potatoes for starch, dextrin, alcohol, etc., require investigation in the United States. Perhaps the most pressing need along this line is the adaptation of a method of drying potatoes, as practiced in Germany, to American conditions, to the end that surplus quantities and culls of this perishable product may be preserved and by removal of its water rendered transportable to market. This problem is closely connected with that of varieties, for the starch content of most American potatoes is low, often too low for profitable drying. Breeding for higher starch content needs to be promoted, as well as breeding for table quality, productivity, and disease resistance.

A nation-wide cooperation for the solution of these different phases of the potato question should not leave out of consideration the problem of values from a national viewpoint: That the cost of producing and distributing potatoes should be kept down to such a point that the market price of this staple food shall be comparable with other staples. Marketing investigations and related problems of distribution demand active support.

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